OESI Power Corporation

June 7, 1991

Mr. William Paty
Chairperson
Department of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

Subj: CHANGES IN DRILLING PROGRAM FOR KS-9, KS-10 AND KS-11

Dear Mr. Paty,

Puna Geothermal Venture (PGV) submitted drilling permit applications to your office in January of this year for production wells KS-9, KS-10 and KS-11. Since then we have made several modifications to our drilling program. We would like to further modify our drilling program as follows:

> Our 9 5/8 inch casing program for KS-9, KS-10 and KS-11 will be the same as that previously submitted for KS-8 in that it will be run and cemented in two stages.

Enclosed are the modified drilling programs for wells KS-9, KS-10 and KS-11. It is anticipated that this drilling program will be maintained for future wells.

Should there be further changes in these or future drilling programs we will notify you.

Sincerely,

Thomas G. Kizis

Thomas G. Kizis
Permit Coordinator

Attachments:

TK/kk

cc: D. Nakano, DLNR
E. Tanaka, DLNR
N. Clark
M. Richard
T. Crowson
File: 7.13.3, 7.12.1 (KS-9), 7.12.1 (KS-10), 7.12.1 (KS-11)

(20797F/kk)

PUNA GEOTHERMAL VENTURE

14-3860 Kapoho Pahoa Road, Pahoa, Hawaii 96778
Post Office Box 1337, Hilo, Hawaii 96721-1337

(808) 961-2786
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APPLICATION FOR PERMIT TO DRILL PROPOSED GEOTHERMAL WELL

KAPOHO STATE 9 RESERVED LANDS, KAPOHO, PUNA, HAWAII

Complying with Department of Land and Natural Resources (DLNR) Administrative Rule, Title 13, Chapter 183, Subchapter 65, Puna Geothermal Venture (PGV) herewith makes application for Permit to Drill for approval by the Hawaii Board of Land and Natural Resources.

1. Applicant:

Puna Geothermal Venture
P.O. Box 1337
Hilo, Hawaii 96721-1337
(808) 961-2786

PUNA GEOTHERMAL VENTURE
By: Thomas G. Kizis
Thomas G. Kizis
Permit Coordinator
Puna Geothermal Venture

Owner of Mining Rights;

Kapoho Land Partnership

Land Owner;

Kapoho Land and Development Company, Limited

2. Proposed well designation: Kapoho State 9 (KS-9) off Wellpad A.

3. The enclosed tax key map, Attachment I, designates the approximate location of the drillsite for KS-9 off Wellpad A located on State Geothermal Mining Lease R-2. The elevation at Wellpad A is approximately 650 feet above mean sea level. A survey of the wellpad for the PGV project is enclosed as Attachment II.

4. The proposed PGV Project geothermal well KS-9 has been designed to maximize the possibility of intersecting, below approximately 4,000 feet, near-vertical fractures which are generally aligned along the axis of the Lower East Rift Zone (LERZ) and which carry geothermal fluids for the purpose of providing geothermal resources to power the PGV Project power plant, previously approved in the Plan of Operation approved March 10, 1989, by the Board of Land and Natural Resources.

5. A detailed Well Drilling and Completion Program, a Drillsite Plan, and a Vertical Section of the well for the KS-9 well are contained in Attachment III.

6. A multi-well drilling bond ($25,000) has previously been filed with the State of Hawaii.

7. Puna Geothermal Venture agrees to perform such drilling as outlined in this application and agrees to maintain the well in accordance with Title 13, Chapter 183, State of Hawaii, and all Federal and County geothermal regulations.

PUNA GEOTHERMAL VENTURE
DRILLING PROGRAM
PRODUCTION WELL KS-9

WELL DATA:

Location:	Wellpad A (See Figure 1).
Datum:	Approximately 650' above MSL.
Projected Depth:	7,400 feet TVD.
Well Type:	Development Well.
Objective:	Fractured Basalt.
Well Completion:	See Figure 4.

GEOLOGY:

FORMATION	DEPTH	LITHOLOGY
Sub-aerial Basalt	Surf-2750'	Dense basalt flows intercalated with cinder scoria zones. Severe lost circulation from 300' to 1200'
Water Table	600'-610'	Depth of sea level.
Shallow Marine Transition Zone	2750'-3600'	Littoral hyaloclastite deposits intercalated with pillow basalt and basaltic dikes.
Submarine Basalt	3600'-T.D.	Pillow basalt crosscut by basaltic dikes and intercalated with minor hyaloclastite units and reef deposits.

(20798F/kk)

CONDUCTOR PIPE AND CELLAR:

Thirty inch (30") A53 Schedule 40 (.375" wall) Grade A or B will be set in a 42" hole that was drilled by a dry hole auger rig to a depth of 50′ below ground level. Alternatively the hole may be drilled using the drill rig with a 17-1/2" bit and 42" hole opener. The conductor is to be cemented in place with a Type II portland concrete cement placed down the backside of the 30" conductor pipe. Order out 10 yds^3 of ready-mix concrete (.57 W/C ratio, 3" - 4" slump, 4% - 5% air, 1" maximum aggregate size).

An 18" rathole will be drilled to rig's dimensions by the same auger rig or by the drill rig using a mud motor. See contractor's rig specifications for the rathole dimensions. Boot the rathole with a 18′ section of 13 3/8" casing. A mousehole is not required.

Following the setting of the conductor pipe, dig a 12′ x 12′ x 11′ earthen cellar and construct a reinforced concrete cellar according to civil contractor's design and specifications (Figure 2).

DRILLING - 26" HOLE:

Rig up Parker # 231 or rig of equal or greater capacity as shown in Figure 3. Following rig up of the Parker # 231, weld on 30" pitcher nipple or Williams 30" rotating head. Spup in with 26" bit. Anticipate losing total returns throughout drilled interval. Continue drilling ahead on water, aerated mud or foam without returns. Use sufficient pump rate to clear the annulus and flush away drill cuttings. Run mud sweeps at least on every connection. Drill ahead with caution noting torque and drag; pick up and check for dray and fill every 10′ to 15′ or as often as hole conditions dictate. Drill to a depth of 650′.

At this depth rig up bailer and bail continuously or as required to get a representative ground water sample. Alternatively, rig a drill pipe swabbing system using swabbing cups and the sand line unit. Trip to bottom with open ended drill pipe. Swab from the 650′ level until a representative ground water sample has been obtained. Collect samples and send to lab for analysis. Have State Representative witness sampling procedure. Notify State 24 hours prior to taking samples.

Resume drilling 26" hole on water, aerated mud, or foam. Drill to a depth of 1000′ to 1200′, the casing point for 20" casing.

Attempt to identify a firm 50' to 100' competent seat for the shoe joint. At casing point sweep hole until no further fill is encountered. Short trip to drill collars for fill.

SURFACE CASING:

Approximately 1200' of 20" 94 #/ft K55 BT&C casing is to be run and cemented in place. Float equipment will consist of a 20" shoe with check valve, one joint of 20" and a 20" float collar with check valve. Tack or strap weld-on the float shoe, the lead joint and the float collar. Centralize the casing with three centralizers - one in the middle of the lead joint, one on the third collar and one on the fifth collar. Run casing while filling on every second joint.

Set casing slips. Mount 20" cementing head with a lead plug and a following plug. Test cement lines to 1200 psi. prior to cementing. Anticipate cementing without returns. Rig separate pressure gauge to record pressure during cementing operation. Maximum cementing pressure is to be 1200 psi.

Cement 20" casing through the casing with a lead plug and a following plug using 3010 ft3 of Type II + 40 % silica flour + 2 % calcium chloride + 0.65 % CFR-3. Excess is calculated at 100 % over theoretical. Cement slurry should be mixed and pumped at a rate of 5 bpm. Attempt to reciprocate casing 5' to 10' using casing elevators. Place 7 bbls (40 ft3) of cement on top of the following plug. Bump plug and pressure up to 300 psi. Hold for 4 hrs. Continue to wait on cement for a total of 12 hrs. Pull 80 % of string weight and hold.

Trip in with a simplified drilling assembly. Pressure test the casing to 600 psi. Drill out the shoe plus 30 feet. Test the shoe to a pressure gradient of 11 ppg equivalent.

If the shoe tests successful, then procede to pick up and run 1" tubing down backside of 20" casing. Tag and record. Mix and pump with the same cement slurry as primary cement above. Circulate to surface.

If the shoe does not test to 11 ppg squeeze the shoe with 200 ft3 of primary cement slurry as above. Hold pressure of 100 psi on the wellbore with the pipe full of water or mud. Wait on cement 8 hrs. Retest the shoe to 11 ppg equivalent. Repeat if necessary.

When the shoe test is successful procede to pick up and run 1" tubing down the backside of the 20" casing. Tag and record depth. Mix and pump with the same cement slurry as primary cement above. Circulate to surface. Wait on cement 12 hrs.

BLOWOUT PREVENTION EQUIPMENT - 17 1/2" HOLE (Figure 5):

Cut off casing and weld on 20" - 2M slip on RTJ flange. Weld on two opposing 2" - 2M or 3" - 2M weld neck flanges for side outlet below flange. Valve the outlets with a 2" x 6" standard nipple and a 2" x 2M ball valve or 3" - 2M RTJ gate valve.

Blowout prevention equipment to drill a 17 1/2" hole should consist of one 21-1/4" - 2M MSP Hydril Type Annular Preventer. Nipple up annular preventer to 20" - 2M flange. Run 2" or 3" diverter line from wing valve outlets on casing to choke manifold and then to reserve pit. Stake and hobble line.

Annular BOP to be tested prior to drilling out the 20" shoe to a pressure of 600 psi. Hold test for 30 minutes. Notify appropriate state regulatory agencies 24 hours prior to testing.

Should the well at anytime begin to flow, the 2"/3" divert line should be opened prior to closing in the annular preventer. The well should be allowed to flow to the pit until enough weighted mud can be mixed to kill the flow.

The annular preventer should be function tested daily. Test should be noted in the IADC tour report as well as in the morning report.

DRILLING 17 1/2" HOLE:

Drill out from underneath the 20" surface casing on pre-treated mud with a 17 1/2" mill tooth bit and slick bottomhole assembly. Dull bit and trip for insert type bit and recommended bottomhole assembly.

Should lost circulation persist, mud sweeps with 40 % - 50 % (50 lb/bbl) of LCM may be attempted but should not be continued if returns are not regained after 3 sweeps. If the returns are not regained cement plugs should used to seal the loss zone. Wait on cement 6 hrs and drill out. Continue to drill.

The 17 1/2" hole is to be drilled to a depth of 2000' where 13 3/8" casing is to run. At casing point, circulate bottoms up and

short trip to the collars. Trip back to bottom and check for fill. Note torque and drag. Circulate bottoms up and trip out to run pipe.

INTERMEDIATE CASING:

Approximately 2000' of 13 3/8" 61# K55 NEW VAM casing is to be run and cemented in place in a single stage. The float equipment should consist of a cement guide shoe, a single shoe joint followed by a load carrying screw-in sleeve float collar. Weld and strap the float equipment and the bottom three joints. Centralize the casing with three centralizers - one midway up the shoe joint, a second on the third collar and a third centralizer on the fifth collar. Fill casing on every second joint.

Land casing one to three feet off bottom. Set casing in slips and make up screw-in stinger on drill pipe. Run inner string drill pipe and screw into float collar. Circulate casing as required for hole conditioning. Full returns should be obtained before commencing the cement job. Pressure test cement lines to 2000 psi prior to cementing. Maximum cementing pressure 2000 psi.

Cement with 100 bbls of water followed by (1) 10 bbls of $CaCl_2$ water, (2) 40 bbls of Super Flush and (3) 10 bbls of water. Mix and pump 1955 sacks (3090 ft^3) of type II cement + 40% silica flour + .65% CFR-3. If losses are encountered below the 20" casing shoe, it may be advisable to cement the 13 3/8" string with a light weight spherlite cement slurry tailed by 200 sacks of type II slurry. Pump 60% excess. Cut cement short if cement returns are obtained at the surface. Reciprocate casing 30' throughout job. Displace cement slurry with water. Bump drill pipe plug before releasing from float collar. Cement slurry should be mixed and pumped at a rate of 5 - 6 bpm. Trip out with inner string drill pipe. Hookup elevators to top of casing. Pull 80% of string weight and hold. Wait on cement for 12 hours. Release weight on casing.

BLOWOUT PREVENTION EQUIPMENT - 12 1/4" HOLE (Figure 6):

Blowout prevention equipment to drill a 12-1/4" hole should consist of 13 5/8" - 3M x 13 5/8" - 5M DSA, 13 5/8" - 5M DG ram preventers and a 13 5/8" - 5M Hydril annular preventer. (See Figure 6). Lay 2" kill line. Test blind rams to 1000 psi. Make up 12 1/4" mill tooth bit and slick bottom hole assembly. Trip in to top of cement. Test pipe rams to 1000 psi. Close annular preventer and pressure test to 600 (as per regs) psi. Notify

appropriate state regulatory agency 24 hours prior to testing.

Pipe rams should be function tested daily and on trips. All BOP tests are to be recorded in the IADC tour report and noted on morning report.

DRILLING 12 1/4" HOLE:

Pre-treat mud with soda ash prior to drilling out shoe joint. Drill out the shoe joint with a 12 1/4" mill tooth bit and slick bottomhole assembly. Conduct leak-off test by pressuring wellhead to 1250 psi with 8.8#/gal mud in hole (equivalent to 11#/gal cement column). Trip for bit change and recommended bottomhole assembly. Drill to 2150' and trip to pickup mudmotor and bent sub. Build angle at 3 deg./100' to 8 to 10 degrees and adjust azimuth as per drilling target. POH, lay down mud motor and RIH with conventional build assembly. Continue building angle to 11 to 15 degrees as required by target. When required angle is reached, POH and RIH with packed assembly consisting of IBS's. Hold angle to with mud to casing point at 3900'. Should any losses be encountered while drilling, heal the loss zones as described in the 17 1/2" section of hole before drilling deeper. Previous wells drilled through this section have not reported any mud loss.

PRODUCTION CASING:

The 9 5/8" string will be run as a liner with a tieback according to the following procedure.

Pick up 1950' 9 5/58" 47# C-90 NEW VAM with float shoe, single shoe joint and float collar.

Thread lock float equipment and bottom three joints. Pick up Hyflo 9 5/8" x 13 3/8" L-80 liner hanger with Brown type 6' extension, 9 5/8" setting sleeve and landing collar.

Pick up 1980' of 5" drill pipe. Trip in the hole and circulate liner with mud. Set liner hanger. Sting out of liner and sting back in. Circulate preflush of 100 bbls water followed by 10 bbls of CACL, 40 bbls or Super Flush and 10 bbls of water spacer. Cement with 790 ft3 Type II cement + 40 % silicda flour + 50 #/sk Spherulite + 4 % gel + 1.25 % CFR-3 + 1.5% HALAD-22. Excess is calculated at 30%.

Sting out of liner hanger. Pull 1 stand up and reverse circulatye excess cement out of hole. Wait on cement 8 hours.

Run in hole with 12 1/4" tooth bit and drill out cement to top of the liner hanger.

Displace hole with air and foam. Pick-up 1970' 9 5/8", 47#, C-90, new VAM with float collar 1 joint from bottom. Sting into top of liner hanger and open ports. Cement to surface with 790 ft3 type II cement + 40% silica flour 2% gel + 0.65% CFR-3. Maintain cement weight of >16.2 lb/gal. Excess is calculated at 30%.

Displace with water. After plug is bumped immediately unbolt and raise BOPs at casing head flange. Drain casing head and set 9 5/8" casing alignment bowl. Wait on cement 12 hours. After WOC, cut off 9 5/8" casing. Dress casing above casing head with 27 1/2 deg. chamfer. Nipple-up 13 5/8" - 3M x 10" - 3M type S WKM Expansion Spool with packing sleeve.

BLOWOUT PREVENTION EQUIPMENT 8 1/2" HOLE (Figure 7):

Blowout prevention equipment to drill the 8 1/2" section of hole should consist of a 10" - 3M WKM gate valve, 10" - 3M x 12" - 5M DSA or cross-over spool, 12" - 5M SG ram preventer, 12" - 5M diverter spool (banjo box), 12" - 5M DG ram preventers, 12" - 5M annular preventer, 12" - 5M x 30" - 300 ANSI crossover spool followed by a 30" Williams rotating head.

Blank off 8" outlet on banjo box with 8" - 5M blind flange. Pressure test blind rams to 1000 psi. Make up 8 1/2" mill tooth bit with slick bottomhole assembly and trip into top of cement. Test upper and lower set of pipe rams to 1000 psi. Next close annular preventer and test to 600 psi. Notify appropriate state regulatory agencies 24 hours prior to testing.

The annular preventer and pipe rams should be functioned tested daily. Function test blind rams on trips. Note BOP tests in the IADC tour report as well as in the daily morning report.

DRILLING 8 1/2" HOLE:

Drill out from underneath the 9 5/8" casing on water with an 8 1/2" mill tooth bit and slick bottomhole assembly.
Trip for packed BHA and 8-1/2" button bit. Displace to storage tanks and continue drilling ahead on mud. Losses can be combatted with LCM products.

Should differential sticking occur, rig up the air compressor with the degasser to free the stuck string.

At 7400' TVD circulate out mud with fresh water. Trip-out of hole and rig up injection test. If test is successful, run production liner.

PRODUCTION LINER

Trip in hole with slick BHA and check for fill. If hole is opened, run approximately 3990' of 7" 29# L-80 BT&C casing slotted with 1/4" x 2" slots on 16 per foot pattern. Run liner with cement guide shoe on bottom. Make up casing on 7" x 9 5/8" cone type liner hanger without slips. Place liner on bottom. Determine and record top of liner position. No float equipment or centralizerss are to be run. Top section of production liner is to be run with no less than 3 joints of blank. Prefered configuration is to run blank to top of the production minus 600'. Release from hanger and trip out laying down.

Nipple down BOP and install final wellhead. (Figure 8)

MUD PROGRAM:

<u>26" Hole</u>

Mud System:	Water

<u>17 1/2" Hole</u>

Mud System:	Low solids non-dispersed. Mud up with 15 - 20 lb/bbl of bentonite and 0.5 lb/bbl of caustic. Lo-Sol can be used to extend the yield of bentonite while selectively flocculating low yield native solids.
Mud Weight:	8.8 - 9.0 ppg. Run solids control equipment
Viscosity:	38 - 42 sec/qt
Water Loss:	15 cc/30 sec
Total Hardness:	Maintain hardness below 150 ppm with soda ash
Filtrate:	No Control
pH:	Maintain pH of 9.5 - 10.5 for H_2S
Comments:	Mud losses may be encountered below the casing shoe. Losses below 1300' are not anticipated.

12 1/4" Hole

Mud System:	Low solids non-dispersed
Mud Weight:	8.8 - 9.0 ppg. Maintain weight as low as possible with water and mechanical solids control equipment. Run contractor's desander and desilter. Dump shale tanks as required.
Viscosity:	38 - 42 sec/qt. Maintain viscosity with gel and caustic. Drispac at a ratio of 8:1 may be used to increase viscosity if needed. As mud temperature increases drispac will become less effective. Alcomer 120L, which is recommended, is an effective viscofier in the higher temperature ranges.
Water Loss:	15 cc/30 sec or less. Strict water loss control through the basalt is not required. However, lenses of clay may be encountered from time to time. While drilling with a mud motor, a water loss below 15 cc/30 sec is recommended.
Total Hardness:	Keep hardness below 150 ppm with soda ash.
pH:	9.5 - 10.5. Maintain with caustic soda
Comments:	Loss of circulation is not anticipated through this interval of hole. Should minor losses occur they can be treated with LCM fiber products. For total loss of returns a cement squeeze is recommended.

8 1/2" Hole

Mud System:	Low solids, non-dispersed.

DEVIATION:

INTERVAL	MAXIMUM DEVIATION	MAXIMUM ANGLE	MAXIMUM DOGLEG
0′ - 500′	200′	1°	1°/100′
500′ - 1000′	250′	1°	1°/100′
1000′ - 2150′	250′	2°	1°/100′
2150′ - 7400′	1500′	As required by target	4°/100′

KOP will be 150 feet below the 13 3/8" casing shoe. The bottomhole target along with the directional plan will be supplied before the well spuds.

Take advantage of bit trips to run a survey. Report accurately the actual instrument depth of the survey along with the corrected course direction.

BOTTOMHOLE ASSEMBLY:

<u>26" Hole</u>

Holding Assembly:

26" Bit
Rubber Sleeve Stabilizer
10" Monel Drill Collar
Rubber Sleeves Stabilizer
2 - 10" Drill Collars
10 - 8" Drill Collars

<u>17 1/2" Hole</u>

Holding Assembly:

17 1/2" Bit
17 1/2" Integral Blade Stabilizer (IBS)
or
17 1/2" 3-point Roller Reamer
10" Monel Drill Collar

17 1/2" Integral Blade Stabilizer
1 - 10" Drill Collars

17 1/2" Integral Blade Stabilizer
10 - 8" Drill Collars

12 1/4" Hole

Building Assembly:
12-1/4" Bit
12 1/4" 3-point Roller Reamer {UG IBS may be more desirable depending upon angle and course direction}

8" Monel Drill Collar
11 - 8" Drill Collars
7 3/4" Drilling Jars
6 - Heavy Weight Pipe

Holding Assembly:

12 1/4" Bit
12 1/4" 3-point Roller Reamer
8" Monel Drill Collar
12 1/4" Integral Blade Stabilizer
11 - 8" Drill Collars
7 3/4" Drilling Jars
6 - Heavy Weight Pipe

8 1/2" Hole

Holding Assembly:

8 1/2" Bit
8 1/2" 3-point Roller Reamer
6½" Monel Drill Collar
8½" 3-point Roller Reamer
1 - 6½" Drill Collar
8½" Integral Blade Stabilizer
16 - 6½" Drill Collars
6 3/4" Drilling Jars
6 - Heavy Weight Pipe

SAMPLES:

Collect drill cuttings as follows:

- 26" Hole every 30'

- 17 1/2" Hole every 30'
- 12 1/4" Hole every 10'
- 8 1/2" Hole every 10'

Formation samples are to be caught as above or as directed by Ormat representative. Samples to be collected by mud loggers for analysis.

SUMMARY OF DRILLING PROCEDURE.

1. Construct location. Move in dryhole digger and drill conductor hole. Alternatively, mover drill rig on hole and drill 42" hole with 17-1/2" bit and hole opener. Set 50' of 30" conductor pipe. Concrete in with 10 yards of ready mix. Civil contractor to dig and construct cellar 12' x 12' x 11'.

2. Move in and rig up drill rig. Spud in well with 26" bit. Drill to a depth of 1200'. Anticipate upon losing complete returns as shallow as 150'.

3. At 650', rig up bailer and bail well until clean. Collect a representative sample of ground water. State of Hawaii should witness sampling procedure. Notify 24 hours prior to sampling.

4. Resume drilling. Drill to a depth of 1200'. Run 20" 94# K55 BT&C casing. Cement with 1900 sacks (3010 ft^3 of Type II Hawaii cement + 40% silica flour + 2% $CaCl_2$ + .65% CFR-3. Cement calculated at 100% excess. WOC.

5. Cut off casing and weld on casing head flange. Nipple up 21¼" annular hydril. Test BOP to 600 psi.

6. Drill out from underneath the 20" casing with a 17 1/2" bit. Drill to a depth of 2000'. Some mud losses may occur from 1000' to 1300'. Combat losses with LCM products.

7. At 2000' run 13 3/8" 61# K55 NEW VAM casing. Cement casing with 1955 sacks (3090 ft^3/sk) of Type II portland + 40% silica flour + .65% CFR-3. WOC

8. Cut off 13 3/8" casing and weld on casing head flange. Nipple up BOP stack. Test rams to 1000 psi and hydril to 500 psi.

9. Drill out from underneath the 13 3/8" casing with 12-1/4" bit to a depth of 2150'. Pick up mud motor and kick well off at 3°/100' toward bottomhole target. Build to 8 degrees and pickup conventional build assembly. Continue to build angle as required by target. Pick locked up BHA and drill to 3900'. Prepare to run 9 5/8" casing.

10. Run 3900' of 9 5/8" 47# C90 NEW VAM casing. Run as

cemented liner and tie back. Cement liner with 230 sacks to yield 782 ft^3 using Type II portland + 40% silica flour + 50 lb/sk of spherlite + 4% gel + 1.25% CFR-3 + HALAD 22A with a weight of 11.2 lb/gal. WOC. Cement tie back with 500 sacks to yield 810 ft^3 using Type II portland + 40% silica flour + 4% gel + 1.25% CFR-3 + HALAD 22A. Maintain weight >16.2 lb/gal. WOC.

11. Nipple up BOP stack. Test rams to 1000 psi and annular hydril to 600 psi. Nipple up flow line, mud-gas separator and rotating head.

12. Drill 8-1/2" hole to 7400' with mud using locked up BHA. Displace hole 1000'-1500' in a TBA course direction to a depth of 7400' TVD.

13. At 7400' displace mud with water and run rig test.

14. Run 3792' of 7" 29# L80 BT&C slotted casing liner. Hang liner off at 3780'. Top three joints are to be left blank.

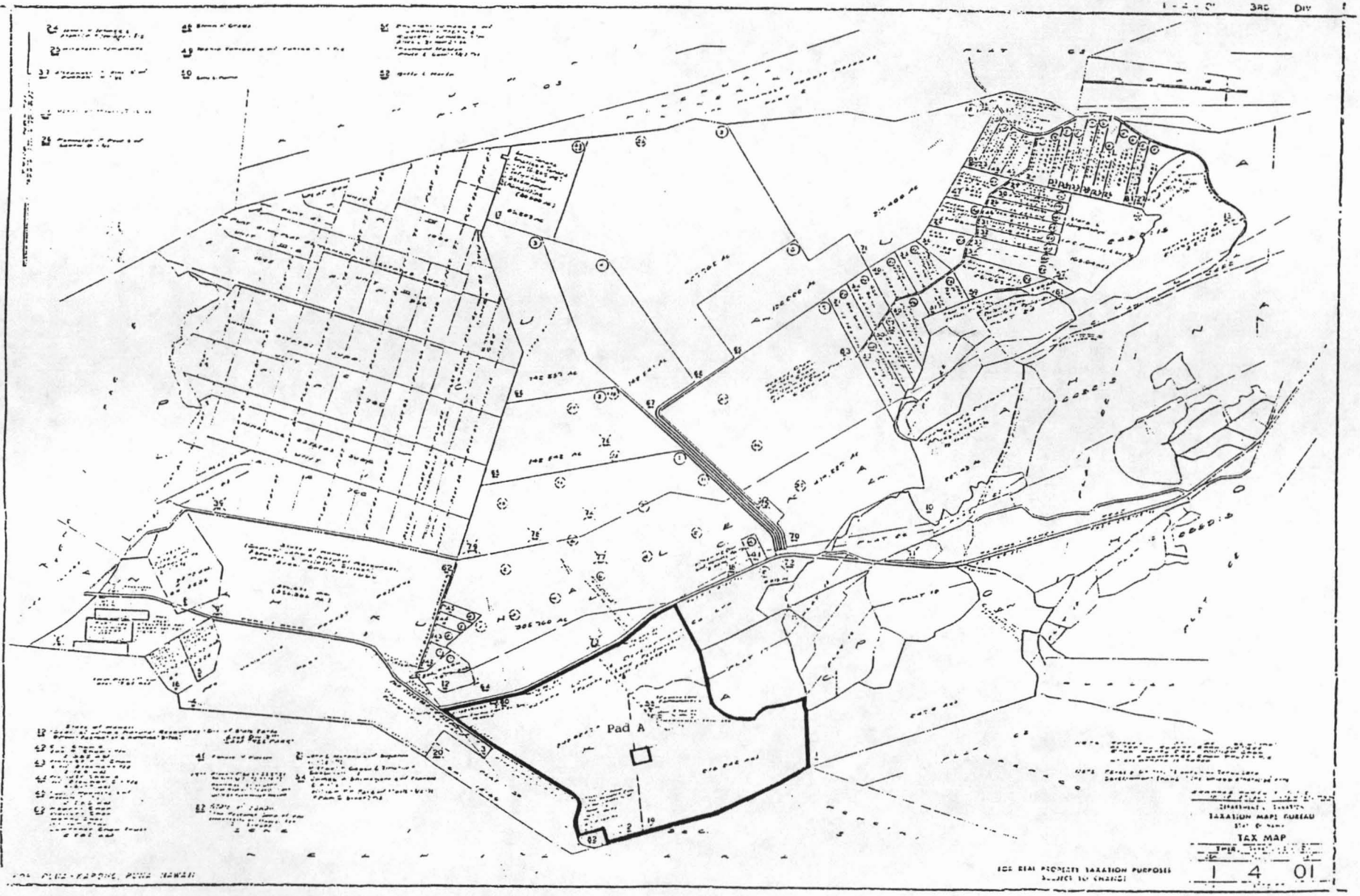
15. Pick up 3850' of 3½" drilling pipe + 3150' of 5½" drilling pipe. Run in hole, clean out to BTM, circulate hole with clean water, and come out laying down drill pipe.

16. Lay down 5" drill pipe. If mud is in the hole pick up 3½" drill pipe. Trip to bottom. Displace any mud that is in the hole.

17. Tear out and move rig. Nipple up wellhead assembly.

CASING AND CEMENT SUMMARY

20" 94# K55 BT&C:	Surface - 1200′
	3010 ft^3 (1900 sacks) of Type II portland cement + 40% silica flour + 40% silica flour + 2% $CaCl_2$ + .65% CFR-3
	Calculated Excess: 100% Slurry Weight - 15.7 ppg Slurry Yield - 1.58 ft^3/sk
13 3/8" 61# K55 NEW VAM:	Surface - 2000′
	3090 ft^3 (1955 sacks) of Type II portland cement + 40% silica flour + .65% CFR-3
	Calculated Excess: 60% Slurry Weight - 15.7 ppg Slurry Yield - 1.58 ft^3/sk
9 5/8" 47# C90 NEW VAM:	Surface - 3900′
	2020 ft^3 (540 sacks) of Type II portland cement + 50 lb/sk of spherlite + 4% gel + 1.25% CFR-3 + 1.5% HALAD - 22A
	Calculated Excess: 60% Slurry Weight - 11 ppg Slurry Yield - 3.72 ft^3/sk
7" 29# L80 BT&C Slotted Liner	3780′ - 7400′ TVD
	slotted with 1/4" x 2" slots on 24 row pattern, top three joints blank.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TAXATION MAPS BUREAU
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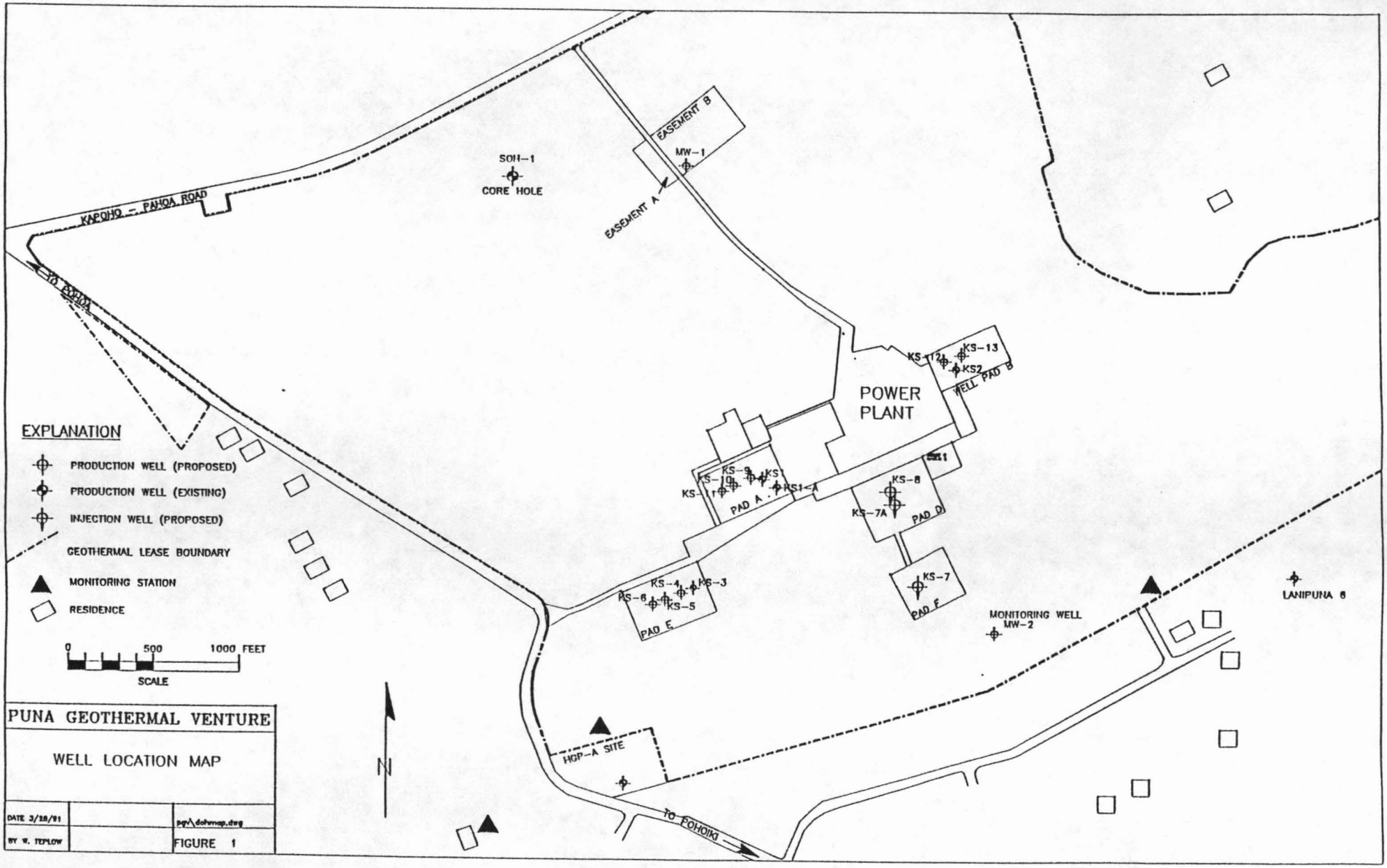
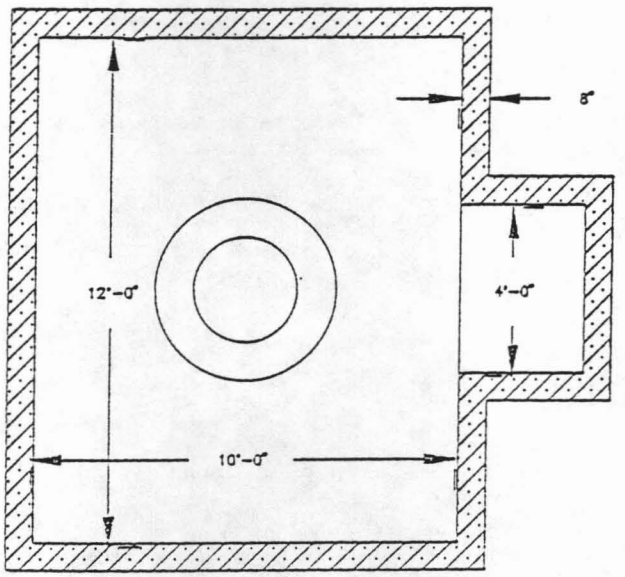
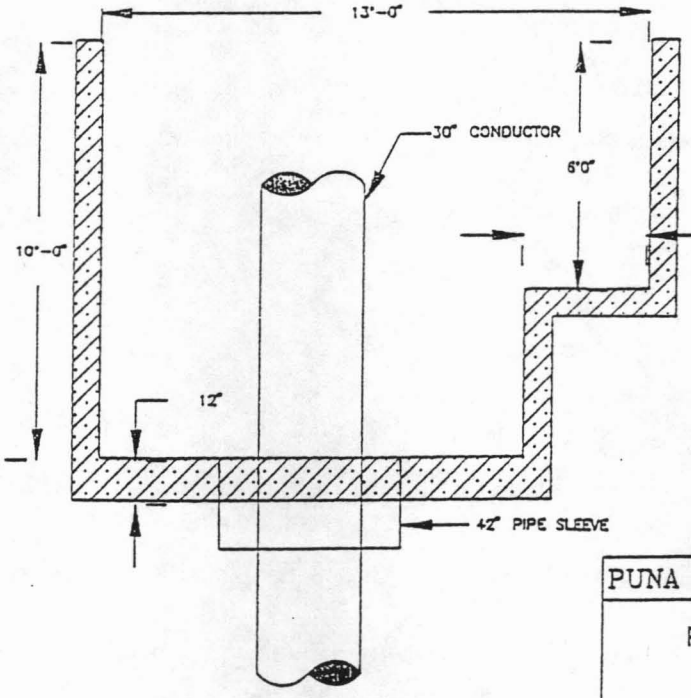

KAPOHO - PAHOA ROAD
TO PAHOA
SOH-1
CORE HOLE
EASEMENT B
MW-1
EASEMENT A
POWER PLANT
KS-12
KS-13
KS2
WELL PAD B
KS-9
KS-10
KS-11
KS1
KS1-A
PAD A
KS-8
KS-7A
PAD D
KS-7
PAD F
KS-4
KS-3
KS-6
KS-5
PAD E
MONITORING WELL MW-2
LANIPUNA 6
HGP-A SITE
TO POHOIKI
EXPLANATION
PRODUCTION WELL (PROPOSED)
PRODUCTION WELL (EXISTING)
INJECTION WELL (PROPOSED)
GEOTHERMAL LEASE BOUNDARY
MONITORING STATION
RESIDENCE
0
500
1000 FEET
SCALE
N
PUNA GEOTHERMAL VENTURE
WELL LOCATION MAP
DATE 3/28/91
BY W. TEPLOW
pgv\dohmap.dwg
FIGURE 1

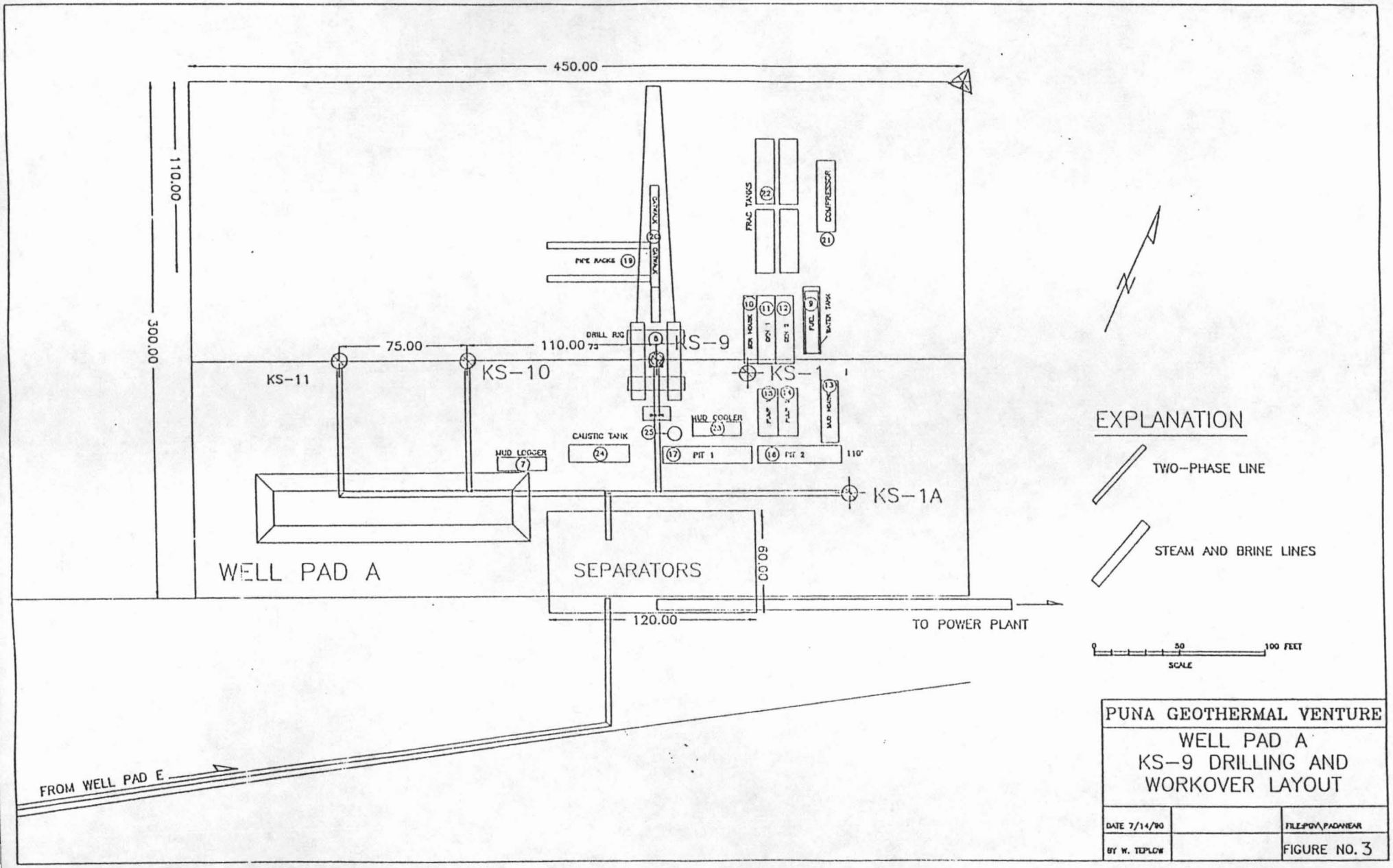


PLAN

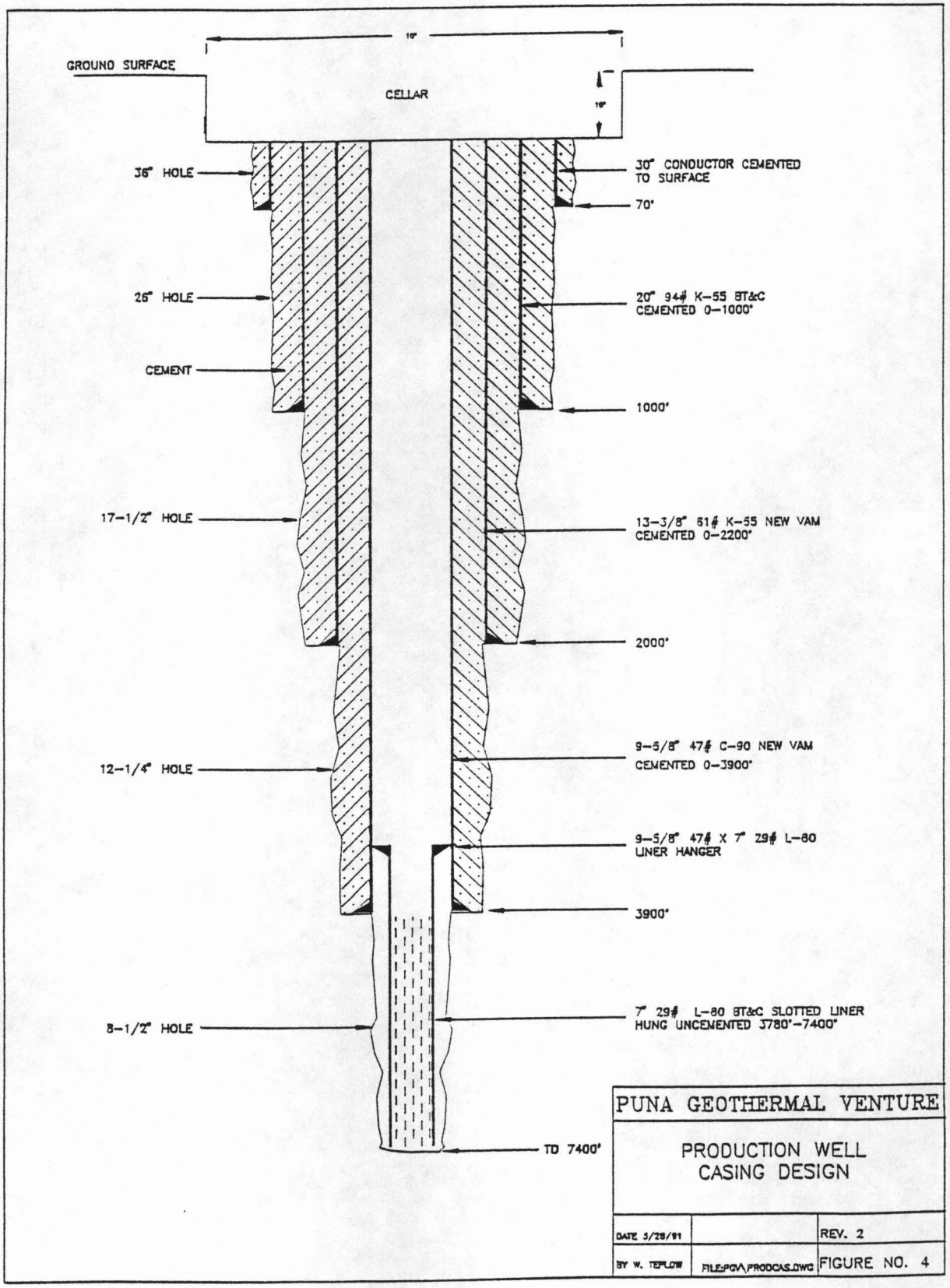


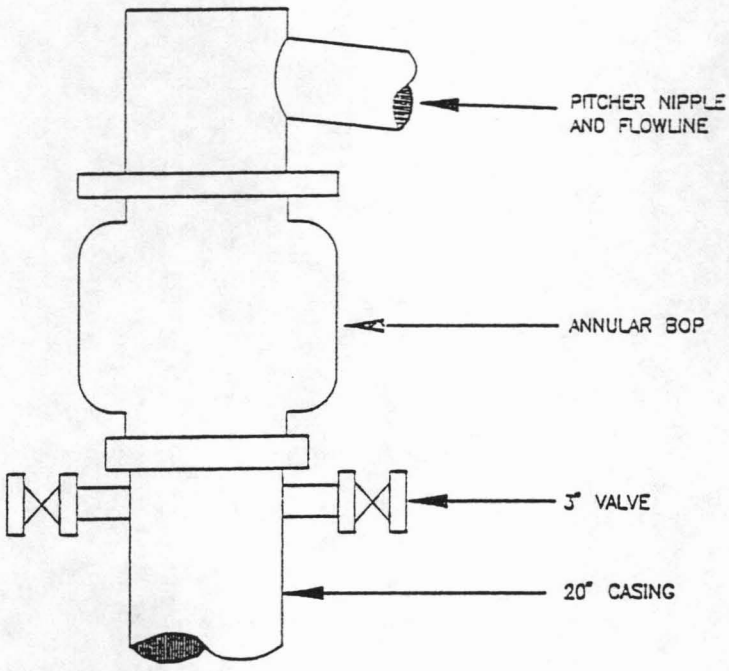
VERTICAL SECTION

PUNA GEOTHERMAL VENTURE		
PRODUCTION WELL CELLAR		
DATE 3/12/90	SCALE 1" = 4'	
BY W. TEPLOW		FIGURE NO. 2

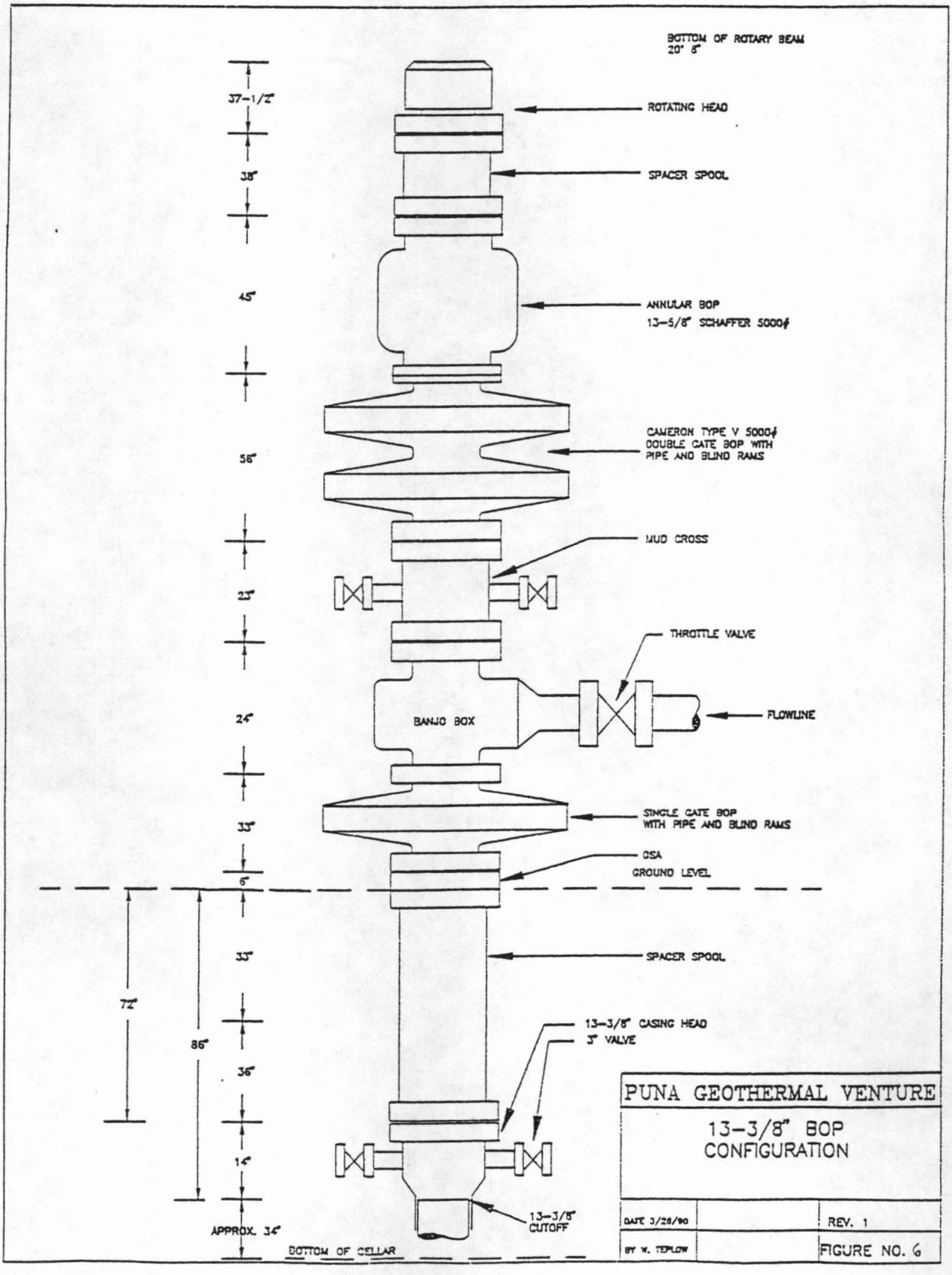


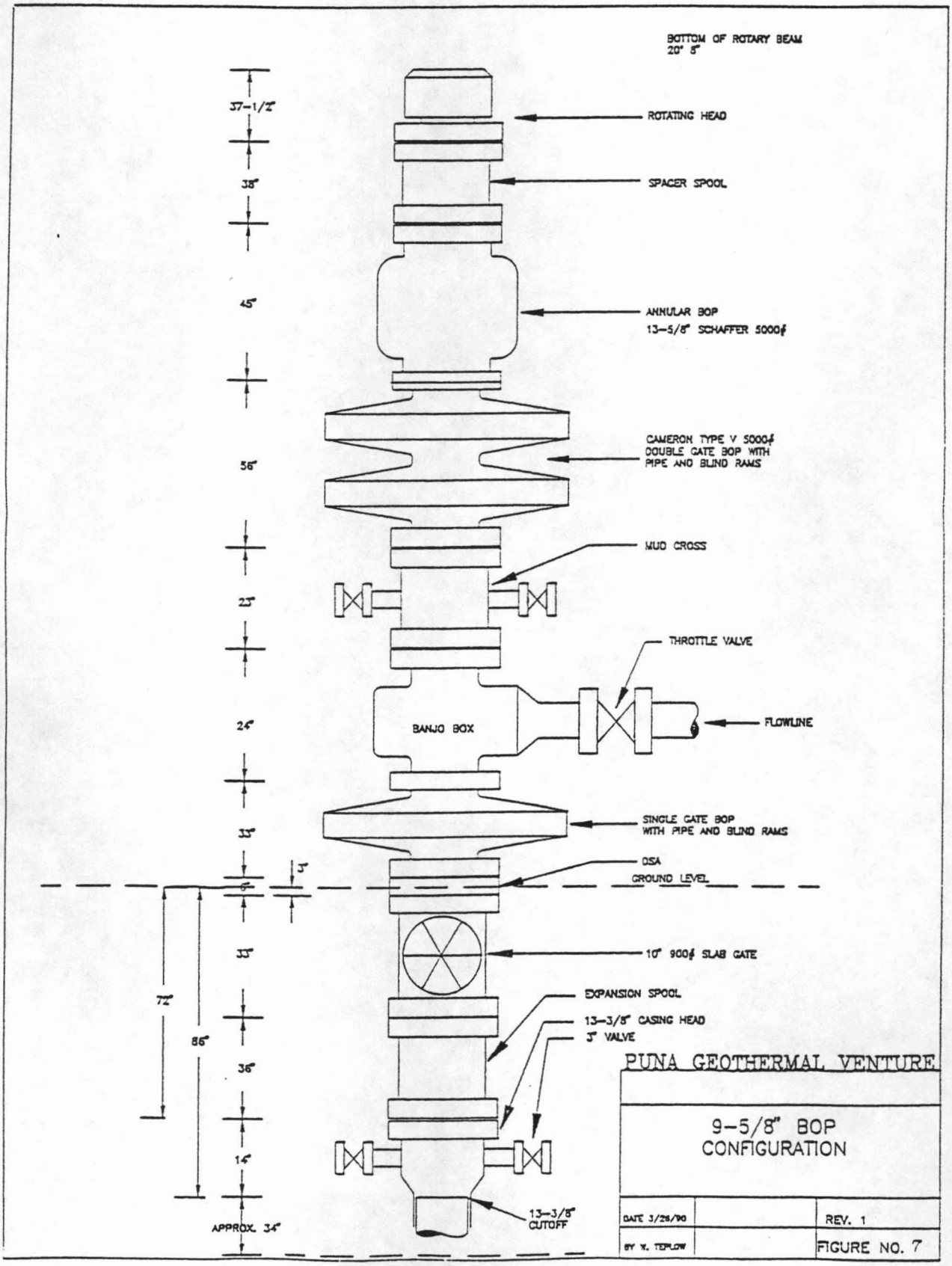
PUNA GEOTHERMAL VENTURE		
WELL PAD A KS-9 DRILLING AND WORKOVER LAYOUT		
DATE 7/14/90		FILE:POV\PADANEAR
BY W. TEPLOW		FIGURE NO. 3

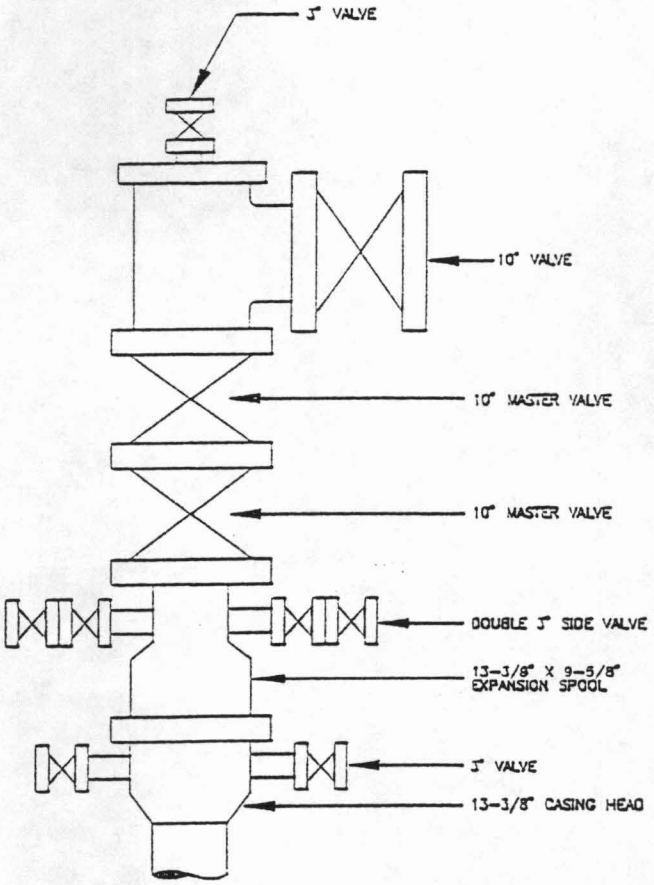

GROUND SURFACE
CELLAR
36" HOLE
26" HOLE
CEMENT
17-1/2" HOLE
12-1/4" HOLE
8-1/2" HOLE
30" CONDUCTOR CEMENTED TO SURFACE
70'
20" 94# K-55 BT&C CEMENTED 0-1000'
1000'
13-3/8" 61# K-55 NEW VAM CEMENTED 0-2200'
2000'
9-5/8" 47# C-90 NEW VAM CEMENTED 0-3900'
9-5/8" 47# X 7" 29# L-80 LINER HANGER
3900'
7" 29# L-80 BT&C SLOTTED LINER HUNG UNCEMENTED 3780'-7400'
TD 7400'
PUNA GEOTHERMAL VENTURE
PRODUCTION WELL CASING DESIGN
DATE 5/28/91
REV. 2
BY W. TEPLOW
FILE:PGV\PRODCAS.DWG
FIGURE NO. 4



PUNA GEOTHERMAL VENTURE		
20" BOP CONFIGURATION		
DATE 3/28/90		REV. 1
BY K. TEPLOW		FIGURE NO. 5


BOTTOM OF ROTARY BEAM
20' 8"
37-1/2"
ROTATING HEAD
38"
SPACER SPOOL
45"
ANNULAR BOP
13-5/8" SCHAFFER 5000#
56"
CAMERON TYPE V 5000#
DOUBLE GATE BOP WITH
PIPE AND BLIND RAMS
MUD CROSS
23"
THROTTLE VALVE
24"
BANJO BOX
FLOWLINE
33"
SINGLE GATE BOP
WITH PIPE AND BLIND RAMS
6"
DSA
GROUND LEVEL
33"
SPACER SPOOL
72"
86"
13-3/8" CASING HEAD
3" VALVE
36"
14"
13-3/8"
CUTOFF
APPROX. 34"
BOTTOM OF CELLAR
PUNA GEOTHERMAL VENTURE
13-3/8" BOP
CONFIGURATION
DATE 3/28/90
REV. 1
BY W. TEPLOW
FIGURE NO. 6


BOTTOM OF ROTARY BEAM
20' 5"
37-1/2"
38"
45"
56"
23"
24"
33"
3"
0"
33"
72"
86"
36"
14"
APPROX. 34"
ROTATING HEAD
SPACER SPOOL
ANNULAR BOP
13-5/8" SCHAFFER 5000#
CAMERON TYPE V 5000#
DOUBLE GATE BOP WITH
PIPE AND BLIND RAMS
MUD CROSS
THROTTLE VALVE
BANJO BOX
FLOWLINE
SINGLE GATE BOP
WITH PIPE AND BLIND RAMS
DSA
GROUND LEVEL
10" 900# SLAB GATE
EXPANSION SPOOL
13-3/8" CASING HEAD
3" VALVE
13-3/8"
CUTOFF
PUNA GEOTHERMAL VENTURE
9-5/8" BOP
CONFIGURATION
DATE 3/26/90
REV. 1
BY Y. TEPLOW
FIGURE NO. 7



PUNA GEOTHERMAL VENTURE		
PRODUCTION WELLHEAD CONFIGURATION		
DATE 3/28/90		REV. 1
BY W. TOPLOW		FIGURE NO. 8